CURCULIONIDAE (WEEVILS) OF THE ALPINE ZONE OF MOUNT KENYA

(Results of the University College Nairobi Mount Kenya Expedition of March 1966—Publication 1)

I. Jabbal
(*Zoology Department, University College, Nairobi*)
R. Harmsen
*Presently at University of Toronto, Toronto, Ontario, Canada.

INTRODUCTION

In March 1966, a number of biologists of University College, Nairobi, under the leadership of Dr. Malcolm J. Coe, undertook a research expedition to the alpine zone of Mount Kenya. The main purpose of the expedition was to study the ecology of the relatively dry northern slopes of Mount Kenya which, from a biological standpoint, were virtually unknown. The Base Camp was erected at 12,500 ft. (3,800 m.) in the Kazita West Valley. Most work was carried out in the vicinity of the camp, but a number of collections were made up to the head of the valley (c. 14,000 ft.—4,300m).

The vegetation in this region is fairly typical of the lower alpine zone: consisting mainly of open tussock grassland and patches of *Carex monostachya* A. Rich. bog on drainage impeded soils. Collections were made in the following situations:

1. *Festuca abyssinica* St-Yves and *F. pilgeri* A. Rich. tussocks.
2. *Lobelia keniensis* R.E. Fr. & Th. Fr. jr. rosettes and inflorescences.
3. Open soil and rocky ground.

RESULTS

Occurrence and Distribution

Appendix 1 includes all the species of Curculionidae so far recorded from the moorland and alpine zones of Mount Kenya (9,000ft.—14,900ft. or 2,700m.—4,500m.). This information has been derived from our own collection and the one of the National Museum of Kenya as well as from a survey of the main relevant works in the literature: A. Hustache (1929) and S. Schenkling (1934).

Ecology

Only five species were found to be of some ecological importance either because of their abundance or as a result of a particular position in a food chain or microhabitat. Other species may well have such importance in other times of the year or in other microhabitats, as yet undiscovered. The ones of obvious ecological importance as discovered so far are:

1. *Parasystates elongatus* Hust.
2. *Cossonus frigidus* Hust.
3. *Seneciobius basirufus* Mshl.
4. *Amphitemetis sulcipennis* Mshl.
5. *Afrotroglorrhynchus* (*nivalis*?) Hust.

The following ecological data were collected for the above listed species:

1. *Parasystates elongatus* Mshl. (Plates 1–3)

A number of adults of this species were collected (from open soil in *Festuca* tussock areas) during day time when weather conditions allowed dispersal and mating activity (air temperature 12°C and direct solar radiation).

During a study of the *Festuca* tussock as an ecological microhabitat, mature and immature adults as well as larvae and pupae of this species were collected from *F. abyssinica* tussocks. The specimens were found in chambers produced by the larva in the region of the tussock just above the stem bases. The main matrix of this region consists of semi-decayed, dead *Festuca* leaves and is penetrated by the living stems of the grass. The beetle larva appears to feed on the lower portions of the live stems, but may derive some nutrition from the dead matter as well. Pupation takes place in the chambers and the adult emerges and matures there as well.

The amount of damage done by *Parasystates* to the *Festuca* tussocks is very limited because of the relative rarity of the species. It is, however, potentially a tussock killer because of its mode of feeding.

This species was mainly found in *F. abyssinica*, but appeared to be uncommon in *F. pilgeri;* whether this reflects a highly selective host specificity or a habitat preference is not known. Within the tussock, the placing of the chamber does reflect a very sensitive microhabitat selection. The chambers are never in the waterlogged region of the tussock below the stem-base and never in the dry upper region. The region in which the chambers are found provides maximum protection against drowning, fire, and predators. This extent of safety to the larvae and pupae makes this species potentially an "outbreak" species which, under certain conditions, could severely damage the *F. abyssinica* cover resulting in considerable changes in the ecomorphology of the alpine zone.

2. *Cossonus frigidus* Hust. (Plates 4–7)

The larvae and pupae of this species were found in very large numbers in the inside of the hollow, recently died, woody regions of the rachis of *Lobelia keniensis*. Here, they appeared to form a major factor in the disintegration of these structures. They were never encountered in living specimens of *Lobelia*, nor in the dead "leaf frills" below the living rosette; this, possibly, because of the more or less anoxic conditions of these habitats. The adults emerge in the dead rachis and must then undertake a period of dispersal and mating. No free moving specimens were collected, but a number of mature adults were found in *Lobelia* inflorescences. It seems probable that the adults are attracted to these inflorescences after dispersal and that they remain stationary here until the flowering period of the *Lobelia* ends and oviposition takes place.

This species obviously does not harm the standing vegetation in any way, and is, therefore, of no influence on the vegetation composition and succession of the alpine zone. The larvae are subject to predation by a number of predatory staphilinid larvae which also inhabit the dead *Lobelia* rachis. There is a further, and perhaps more severe, predation at the time of adult concentration on the *Lobelia* inflorescence by a number of insectivorous song birds. In particular the Hillchat (*Pinarochroa sordida earnesti* Sharpe) and the Scarlet Tufted Malachite Sunbird (*Nectarinia j. johnstoni* Shelley) were regularly observed feeding on the insects in the *Lobelia* inflorescence.

3. *Seneciobius basirufus* Mshl. (Plate 8)

Mature, adult specimens of this attractively coloured beetle were collected from tussock grassland and from among rocks on open, frost heaved soil. They appeared quite lethargic when the air temperature was low but as soon as it became warm they showed considerable activity. Some of them were caught walking, but no mating was observed. One specimen was collected at 14,000′ altitude in a completely moribund state under dead vegetable litter on a cold, cloudy morning (air temp. $\pm 3^{\circ}$C in shady areas).

Of this species, neither larvae nor pupae were encountered.

Because of its considerable size (16.5 mm.) and its local abundance, this species could form a significant percentage of the food of certain mammals or larger birds. Augur Buzzards (*Buteo rufofuscus augur* Rupp.) were often observed catching beetles and hundreds of beetle elytra were found in buzzard pellets; none of these, however, belonged to *S. basirufus*. It is possible that the species is poisonous or distasteful, a situation often found in brightly coloured, slow moving animals.

4. *Amphitemetus sulcipennis* Hust. (Plate 9)

The adults of this species were also collected from among rocks on open soil and from patches of vegetation mainly consisting of *Festuca* tussocks and *Alchemilla* cover. Considerable activity, including mating, was observed as soon as the weather became warm: i.e. air temperature 12°C and direct solar radiation. This beetle was quite common in certain areas and could constitute a major source of protein nutrition for larger birds and such mammals as shrews and insectivorous rodents (e.g. *Lophuromys*). No direct evidence of such predation is available, and Augur Buzzard pellets did not contain *Amphitemetus* elytra. This may be because of the excellent camouflage of these slow moving beetles. Another reason could be that the buzzards find it uneconomical to feed on these small beetles when there are a large number of rodents, shrews and larger beetles available. The beetle's "freezing" behaviour in the presence of human beings suggests that predation is a mortality factor of some significance.

5. *Afrotroglorrhynchus* (*nivalis*?) Hust.

Only two specimens of the beetle belonging to the genus *Afrotroglorrhynchus* were collected while beating *Alchemilla johnstonii* Oliv. This species seems to be very near *A. nivalis* Hust., but according to Dr. Edward Voss* it could be a different species. Jabbal (1968) is at present in the process of describing it as a new species, *Afrotroglorrhynchus kazitae*. Since this beetle is of relatively small size (4.8 mm.) and not very common, it is probably of no quantitative ecological importance.

DISCUSSION

The unique feature of Afro-montane regions is their remarkable diurnal temperature range, under whose influence an animal may be submitted to sub-zero every night and intense heat and low humidity during the day. Hedberg (1957) called this type of climate "winter every night and summer every day". The relative humidity, which in these regions fluctuates daily with the temperature and cloud cover, has been described by Coe (1967): "at ground level the relative humidity just before sunrise was 90%, when the sun rose this figure fell within about 90 minutes to below 20%; when during the course of the day the sun became obscured by cloud, the figure rose to 80%". In such a climate with large and regular diurnal temperature changes it is not so much the extremes, but rather the speed with which they fluctuate, that is the main controlling factor on insect life.

The atmosphere becomes thinner as the altitude increases, thus resulting in lesser heating of the air during the passage of solar radiation. The most important component of this incoming radiation is the ultraviolet. While considering the climate near the ground Geiger (1950) quotes the work of Maurer, who found that the amount by which ground temperature exceeds that of the air increases with altitude, a factor of obviously great significance to microclimate in the equatorial mountains. During the day the outward radiation from the ground and vegetation is not very apparent but at high altitudes its effect is of great importance as an additional cooling agent at the surface and in consequence this effect may be strongly felt by the invertebrates occupying the microhabitats. The sudden lowering of temperature does not, however, penetrate more than a few inches below the, surface of the soil—4 to 6 inches below the ground level, the temperature was found to be c6°C. So in large part, the protective insulating mechanisms that have been developed by the vegetation are fully utilized by the invertebrate fauna.

The activity of insects in such areas is greatly limited and seems to take place in bursts of short duration whenever circumstances are favourable. At night the intense cold renders them incapable of movement, while during the day, except for a short period after sunrise and just before sunset, the ground temperature is far too high and humidity too low. Thus, not surprisingly, it is due to these two factors that a high percentage of arthropods exhibits sedentary and cryptozoic habits, which keep them within or close to the comparatively constant microclimate of their shelters. Examples of this are *Cossonus* in the *Lobelia* rachis and *Parasystates* in the *Festuca* tussock. None of the observed species showed any evidence of rhythmic control over activity.

Morphological factors seem to play an important role in the adaptation of invertebrate life to the alpine climate. The highly reflective surface of some of the beetles like *Parasystates elongatus* is probably a means of protection against radiation. The predominantly dark colours of almost all the weevils collected could be important in heat absorption. It is probably an advantage to absorb heat quickly in the early morning, so that the animal can complete its main period of activity before the ground becomes too hot. All the Curculionids collected possess inflated elytra whose enclosed air could have an important insulating function.

One point of evolutionary interest is the fusion of the elytra and absence of wings in most of the alpine Curculionids. This aptery or brachyptery is a common phenomenon of high altitude insects and Mani (1962) suggests the obvious selective advantage of such a modification. He points out that a flying insect can easily be carried by up-currents on the barren peak region or swept off the mountain altogether. The winds on East African mountains, however, are not generally as strong as those on the Himalayas. Thus, whether the presence of flightless insects on Mount Kenya represents a selective survival of apterous species which have colonized the mountain or whether it represents the evolution of apterous species from normal, winged species after colonization of the mountain is very much a matter of speculation.

During the March 1966 expedition, no attempt was made to collect the smaller species of the family Curculionidae. Yet, of the thirty two previously described species for Mount Kenya four were encountered, and one new species was found (*Afrotroglorrhynchus kazitae* n. sp.). This indicates that a systematic survey of the alpine regions of Mount Kenya will probably uncover a considerable number of weevils as yet undescribed.

The purpose of this expedition was to study the ecology of the northern slopes of the alpine zone of Mount Kenya. The work on Curculionidae as reported above throws some light on the role played by the larger and more abundant species of this family in biological interrelationships. The rarer and smaller species must also play some role in the ecology of this region. At present this role seems to be of little quantitative importance, however, it requires a closer study.

---

*Dr. Edward Voss of 4501 Hardenberg, Am Boberg 2, B. R. Deutschland, kindly examined our specimens.

ACKNOWLEDGEMENTS

The authors would like to express their gratitude to the Director of the Kenya National Parks and to Mr. Bill Woodley for their co-operation. The work was supported by a Ford Foundation grant for Ecological research to the Zoology Department of University College, Nairobi.

BIBLIOGRAPHY

1. Coe, M. J. (1967), The Ecology of the Alpine Zone of Mount Kenya. 134 pp. 20 figs., 24 pl. Junk. Hague.
2. Geiger, R. (1950), The Climate near the Ground. pp. xxi+482. Harvard.
3. Hedberg, O. (1957), Afro-Alpine vascular plants. *Symb. Bot. Upsal.* **15** 1:1–411.
4. Hustache, A. (1929), Voyage de Ch. Alluaud et R. Jeannel en Afrique Orientale, Resultants Scientifiques: Insectes Coleoptères. **19**:367–560.
5. Jabbal, I. (1968), A Description of *Afrotroglorrhynchus kazitae* n. sp. *in.ed.*—MS.
6. Mani, M. S. (1962), Introduction to High Altitude Entomology. London.
7. Schenkling, S. (1934), *Coleopterorum catalogue auspiciis et auxilio, W. Junk*, **28, 29** & **30.**

APPENDIX I

CHECKLIST OF CURCULIONIDAE COLLECTED FROM THE MOORLAND AND ALPINE ZONES OF MOUNT KENYA

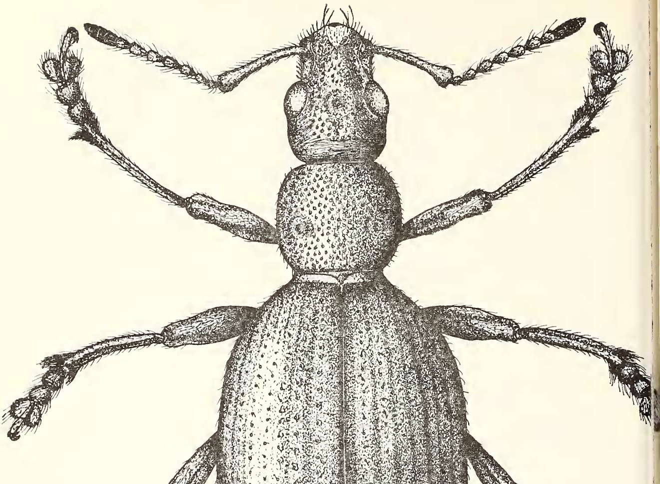
All the names marked * are in the collection of the National Museum of Kenya.

Name Authority	*Collector and Date*	*Altitude*	*References*
A. **Subfamily**: *Otiorrhinchinae*			
1. *Amphitemetus griseus* Hust.	Alluaud & Jeannel 1912	9,200 ft. and 10,500 ft.	Hustache (1929) pp. 384–385.
2. **A. sulcipennis* Hust.	Alluaud & Jeannel 1912	9,200 ft. and 10,500 ft.	Hustach (1929) pp. 385–387.
	Joy Peter Bally Nov. 1943	10,500 ft.	
	Mrs. Bally Jan. 1964	10,500 ft.	
	Jabbal & Harmsen March 1966	12,500 ft.	
3. *Leptospyris sylvaticus* Hust.	Alluaud & Jeannel 1912	9,200 ft. and 10,500 ft.	Hustache (1929) pp. 401–402.
4. *L. glacialis* Hust.	Alluaud & Jeannel 1912	13,100 ft. and 14,400 ft.	Hustache (1929) pp. 402–403.
5. *L. laevis* Hust.	Alluaud & Jeannel 1912	13,100 ft. and 13,400 ft.	Hustache (1929) pp. 403–404.
6. *Parasystates albovittatus* Auriv.	Alluaud & Jeannel 1912	9,200 ft. and 10,500 ft.	Hustache (1929) p. 406.
7. **P. elongatus* Hust.	Alluaud & Jeannel 1912	7,900 ft. and 14,400 ft.	Hustache (1929) pp. 407–408.
	A. J. F. Gedye Dec. 1943	13,500 ft.	
	Museum Staff Jan. 1947	12,150 ft.	
	F. C. Delkirk Feb. 1950	14,850 ft.	
	Harmsen & Jabbal, 1966	12,500 ft.	
8. *P. alternans* Hust.	Alluaud & Jeannel 1912	10,800 ft– 11,500 ft.	Hustache (1929) pp. 408–409.
9. *P. nigripennis* Hust.	Alluaud & Jeannel 1912	7,900 ft. and 10,500 ft.	Hustache (1929) pp. 410–411.
10. *P. alpinus* Hust.	Alluaud & Jeannel 1912	7,200 ft.– 10,200 ft.	Hustache (1929) pp. 413–414.
11. *P. brunneus* Hust.	Alluaud & Jeannel 1912	9,200ft.– 10,500 ft.	Hustache (1929) pp. 414–415.
12. *Systates elongatus* Hust.	Alluaud & Jeannel 1912	7,900 ft. 9,200 ft. and 10,500 ft.	Hustache (1929) pp. 424–425.
13. *Barypeithes microphthalmus* Hust.	Alluaud & Jeannel 1912	9,200 ft.– 10,500 ft.	Hustache (1929) pp. 450–451.
14. *Onias* (*Neomias*) *kenyae* Hust.	Alluaud & Jeannel 1912	9,200 ft.– 10,500 ft.	Hustache (1929) pp. 451–452.
15. *O.* (*Neomias*) *kenyae* var. *glacialis* Hust.	Alluaud & Jeannel 1912	13,100 ft.– 13,400 ft.	Hustache (1929) p. 452.
16. *O.* (*Neomias*) *alpinus* Hust.	Alluaud & Jeannel 1912	10,800 ft.– 13,400 ft.	Hustache (1929) pp. 452–457.
B. **Subfamily**: *Cleonidae*			
17. *Lixus nycterophorus* var. *kenyae* Hust.	Alluaud & Jeannel 1912	7,900 ft.– 8,900 ft.	Hustache (1929) p. 474.
18. **L. alpinus* Hust.	Mrs. Bally Jan. 1944	10,500 ft.	Hustache (1929) p. 475.

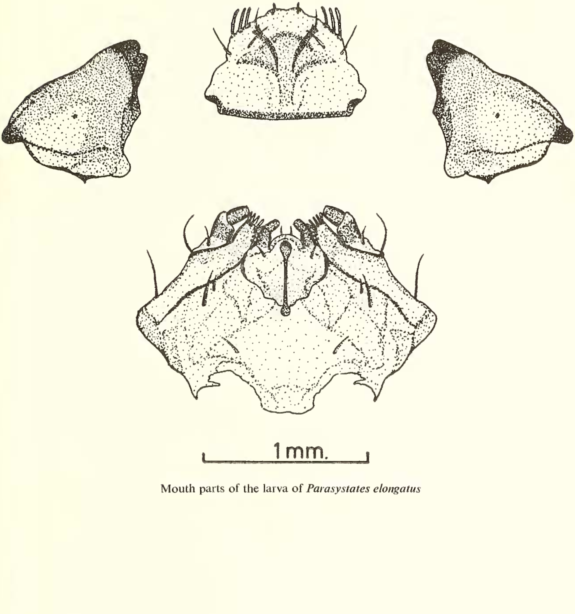
Name Authority	*Collector and Date*	*Altitude*	*References*
19. **L. adspersus* Boh.	Mrs. Bally Jan. 1944		Boheman (1871) *Fahrs. Oefrers. Vet. Akad. Forh.* **18**: 58, 230.
C. **Subfamily**: *Rhyparosominae*			
20. **Oreoscotus fulvitarsus* Hust.	Alluaud & Jeannel 1912	10,800 ft. and 11,500 ft.	Hustache (1929) pp. 465–466.
	A. J. F. Gedye Dec. 1934	10,000 ft.	
	Museum Staff Jan. 1947	12,150 ft.	
	Mrs. Bally Jan. 1944	10,500 ft.	
D. **Subfamily**: *Eirrhininae*			
21. *Homoedenodema fulva* Hust.	Alluad & Jeannel 1912	9,200 ft. and 10,500 ft.	Hustache (1929) pp. 483–484.
E. **Subfamily**: **Apioninae**			
22. *Apion warendorffi* Wagner	Alluad & Jeannel 1912		*Mem. Soc. Ent. Belg.* **19**: 41.
F. **Subfamily**: **Baridinae**			
23. *Baris kenyae* Hust.	Alluad & Jeannel 1912	9,200 ft. and 10,500 ft.	Hustache (1929) pp. 531–533.
G. **Subfamily**: *Cossoninae*			
24. *Mimus glacialis* Hust.	Alluaud & Jeannel 1912	9,400 ft.	Hustache (1929) pp. 544–545.
25. **Cossonus* (or *Afrocossonus*) *hyperboreus* Hust.	Alluaud & Jeannel 1912	10,800 ft. and 11,700 ft.	Hustache (1929) pp. 545–546.
	Museum Staff Jan. 1947	12,150 ft.	
26. *C. dorytomoides* Hust.	Alluaud & Jeannel 1912	10,800 ft. and 12,100 ft.	Hustache (1929) pp. 547–548
27. **C. frigidus* Hust.	Alluaud & Jeannel 1912	13,100 ft. and 14,400 ft.	Hustache (1929) pp. 549–550.
	Museum Staff Jan. 1947	12,150 ft.	*Rev. Zool. Bot. Afr.* (1934) **26**: 36.
	A. J. F. Gedye Dec. 1934	13,800 ft.	
	Jabbal & Harmsen March 1966	12,500 ft.	
28. **C.* (or *Pseudo-mesites*) *glacialis* Hust.	Alluaud & Jeannel 1912	10,800 ft. and 12,100 ft.	Hustache (1929) pp. 552–553.
	A. J. F. Gedye Dec. 1934	13,800 ft.	*Rev. Zool. Bot. Afr.* (1934). **26**: 36.
	Museum Staff Jan. 1947	11,000 ft.	
H. **Subfamily**: *Otiorrhinchinae*			
29. **Seneciobius basirufus* Mshl.	Mrs. Bally Aug. 1934	12,000 ft.	*J. E. Afr. Nat. Hist. Soc.* (1950). **19**, 5: 147.
	Mrs. Bally Jan. 1944	10,500 ft.	
	Museum Staff Jan. 1947	12,150 ft.	
	Jabbal & Harmsen March 1966	12,500 ft. and 14,000 ft.	

Name Authority	Collector and Date	Altitude	References
30. **S. semilucens* Mshl.	A. K. Hading 1949	11,000 ft.	*J. E.A. Nat. Hist. Soc.* (1950). **19**, 5:147
31. **Strictoseneciobius ebininus* Hust.	Mrs. Bally 1944	10,500 ft.	*Ann. Mag. Nat. Hist. London* (1940). (11) **13**:93–98
32. **Seneciobius loveni* Aur. or *granulipennis* Hust.	A. K. Hading 1949	13,000 ft.	*Rev. Zool. Bot. Afr.* (1923) **11** 188. *Ann. Mag. Nat. Hist.* (1934). (10) **15**:503

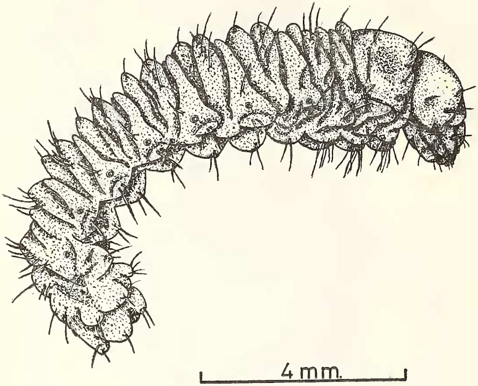
(*Received 30th January 1968*)



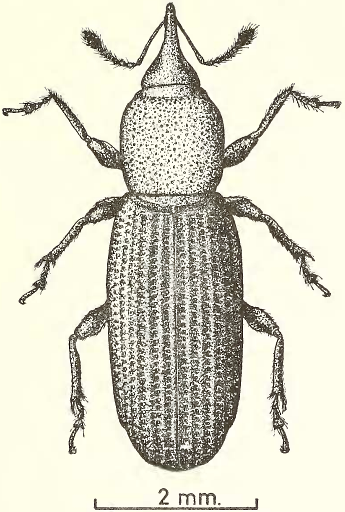
Parasystates elongatus Hust.



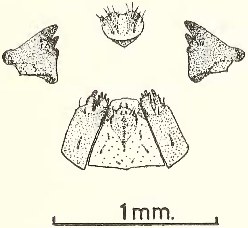
Mouth parts of the larva of *Parasystates elongatus*



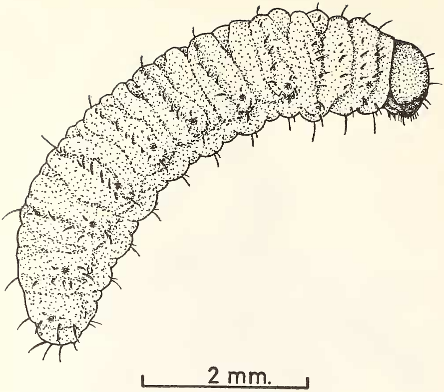
Larva of *Parasystates elongatus*



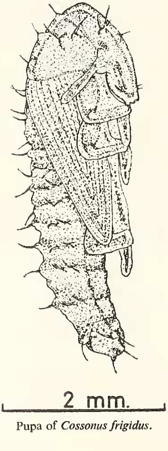
Cossonus frigidus Hust.



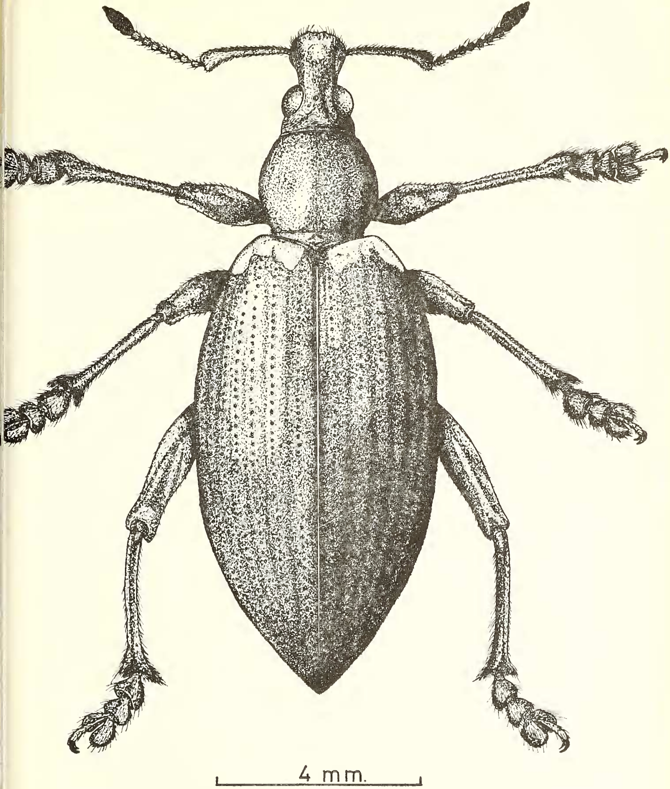
Mouth parts of the larva of *Cossonus frigidus.*



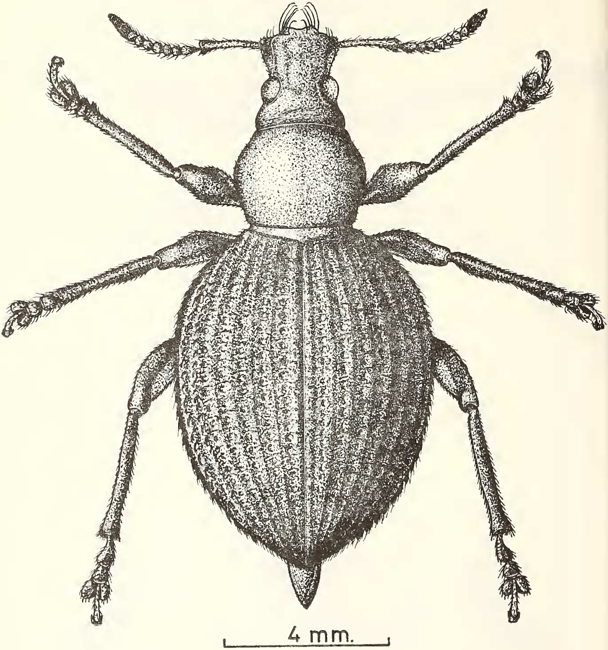
Larva of *Cossonus frigidus*.



Pupa of *Cossonus frigidus*.



Seneciobius basirufus Mshl.



Amphitemetus sulcipennis Hust.